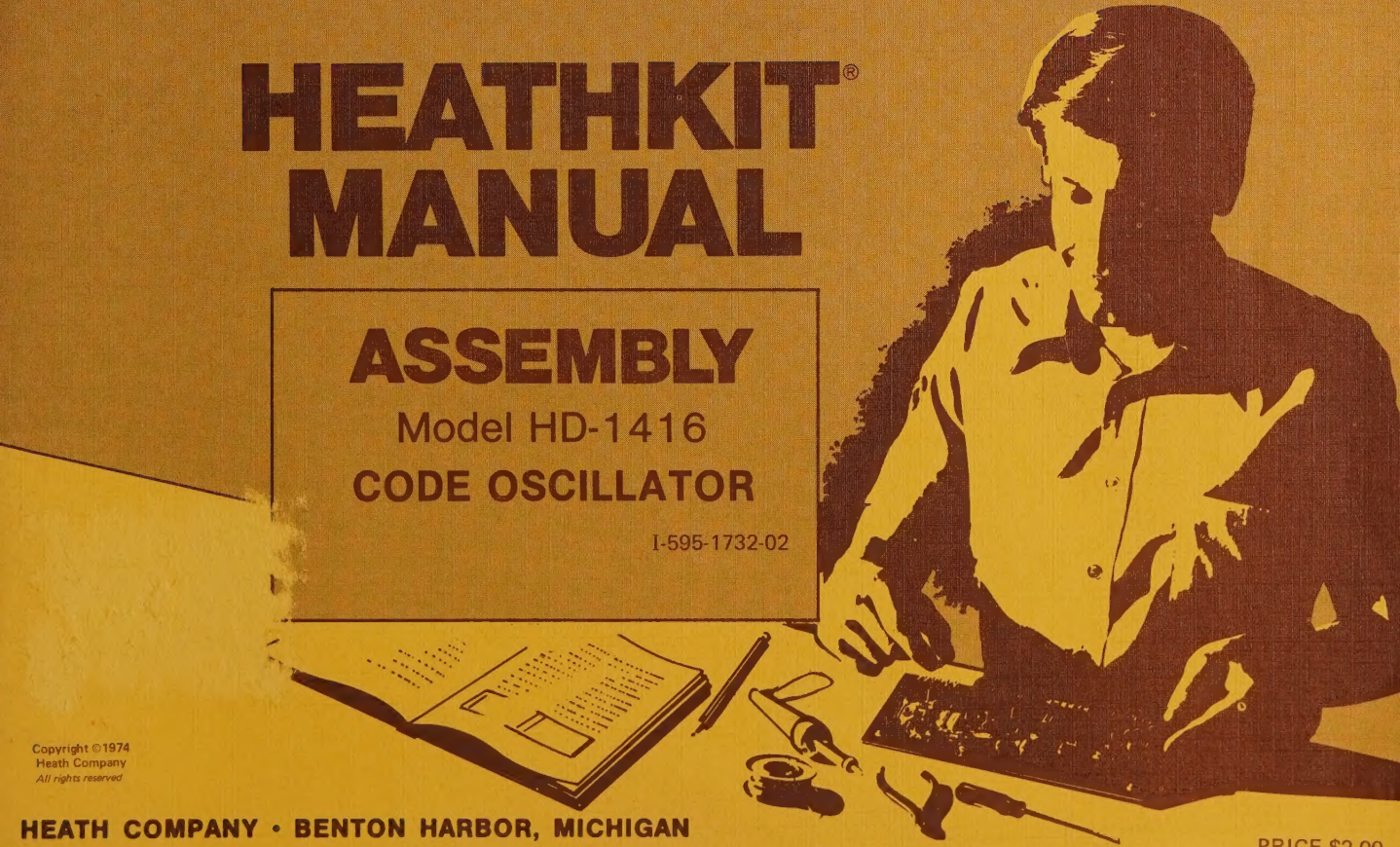
HEATHKIT® MANUAL

ASSEMBLY

Model HD-1416

CODE OSCILLATOR

I-595-1732-02



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PRICE $2.00

YOUR HEATHKIT 90-DAY FULL WARRANTY

During your first ninety (90) days of ownership, Heath Company will replace or repair free of charge — as soon as practical — any parts which are defective, either in materials or workmanship. You can obtain parts directly from Heath Company by writing us or telephoning us at (616) 982-3571. And we'll pay shipping charges to get those parts to you — anywhere in the world.

We warrant that, during the first ninety (90) days of ownership, our products, when correctly assembled, calibrated, adjusted, and used in accordance with our printed instructions, will meet published specifications.

If a defective part or error in design has caused your Heathkit product to malfunction during the warranty period, through no fault of yours, we will service it free upon delivery at your expense to the Heath Factory, Benton Harbor, Michigan, or to any Heathkit Electronic Center (units of Schlumberger Products Corporation), or through any of our authorized overseas distributors.

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Our warranty, both expressed and implied, does not cover damage caused by use of corrosive solder, defective tools, incorrect assembly, misuse, fire, customer-made modifications, flood or acts of God, nor does it include reimbursement for customer assembly or setup time. The warranty covers only Heath products and is not extended to non-Heath allied equipment or components used in conjunction with our products or uses of our products for purposes other than as advertised.

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HEATH COMPANY
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The following telephone numbers are direct lines to the departments listed:

Kit orders and delivery information	(616) 982-3411
Credit	(616) 982-3561
Replacement Parts	(616) 982-3571
Technical Assistance:	
R/C, Audio, and Electronic Organs	(616) 982-3310
Amateur Radio	(616) 982-3296
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Assembly and Operation of the

HEATHKIT

CODE OSCILLATOR

MODEL HD-1416

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HEATH COMPANY
BENTON HARBOR, MICHIGAN 49022

INTRODUCTION

The Heathkit Model HD-1416 Code Oscillator provides you with a simple and inexpensive means of learning the Morse code. The key furnished with the Kit is the only external item you require to form audible code characters. Power is supplied by an inexpensive and easy-to-get 9-volt battery.

An audible signal is provided by an astable multivibrator. You can adjust the volume and tone of the signal for the level and pitch you desire.

A phone jack is provided so you can use headphones for private listening.

This Code Oscillator provides you with the means to develop the ability to receive and transmit code. You must have both of these abilities to obtain an amateur radio license from the Federal Communications Commission. We recommend that two persons learn the code together by sending to each other. Additional comments on this subject are in the "Learning the Code" section of this Manual.

The styling of the Code Oscillator is compatible with the SB series of Heath amateur radio equipment. This versatile, portable, safe, and reliable Code Oscillator will have a strong appeal to those individuals or groups who have a sincere desire to learn the Morse code.

Refer to the "Kit Builders Guide" for information on unpacking, parts identification, tools, wiring, soldering, and step-by-step assembly procedures.

PARTS LIST

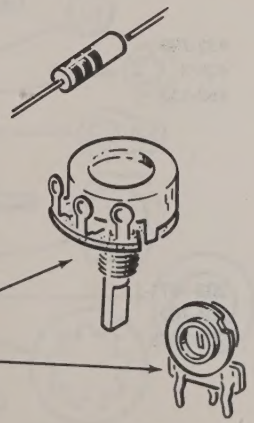
Check each part against the following list. Make a check (✓) in the space provided as you identify each part. Any part that is packed in an individual envelope with the part number on it should be placed back in the envelope after it is identified until it is called for in a step. Do not throw away any packing materials until all parts are accounted for.

To order a replacement part, use the Parts Order Form furnished with this kit. If a Parts Order Form is not available, refer to "Replacement Parts" inside the rear cover of the Manual.

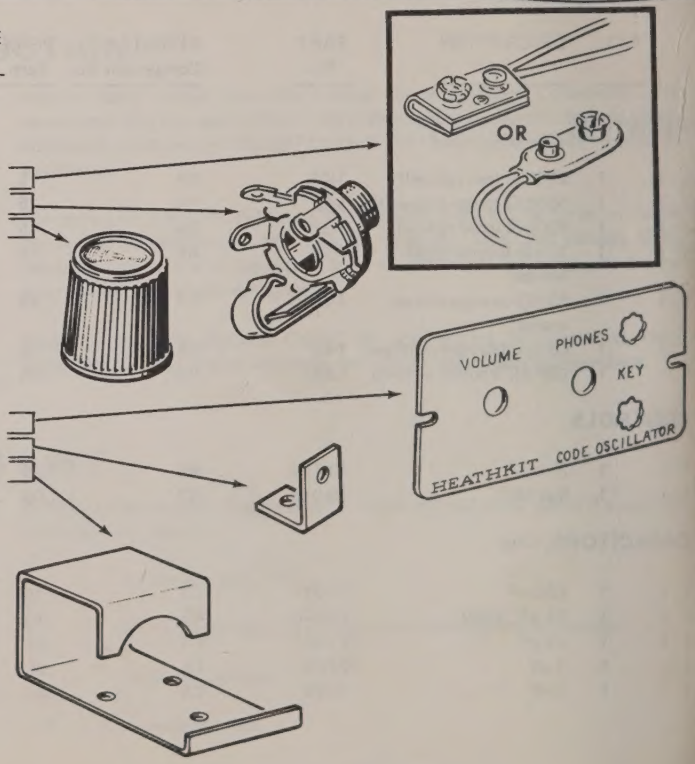
Each circuit part in this kit has its own component number (R2, C4, etc.). Use these numbers when you want to positively identify the same part in the various sections of the Manual. These numbers, which are especially useful if a part has to be replaced, appear:

- In the Parts List.
- At the beginning of each step where a component is installed.
- In some illustrations.
- In the Schematic.
- In the sections at the rear of the Manual.

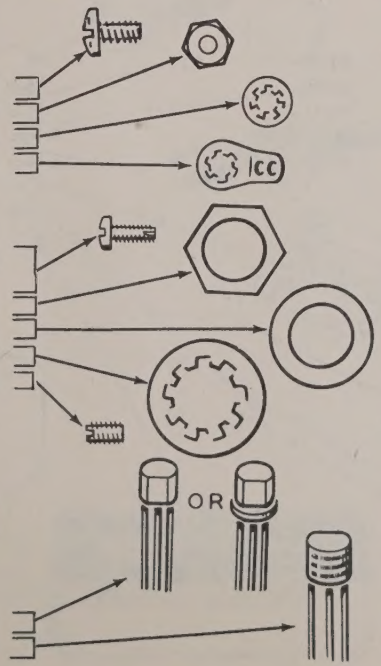
	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.	PRICE Each
RESISTORS					
( )	1	2200 Ω (red-red-red)	1-44	R6	.15
( )	1	5600 Ω (green-blue-red)	1-18	R5	.15
( )	1	8200 Ω (gray-red-red)	1-73	R9	.15
( )	1	10 kΩ (brown-black-orange)	1-20	R1	.15
( )	1	33 kΩ (orange-orange-orange)	1-24	R7	.15
( )	1	68 kΩ (blue-gray-orange)	1-60	R4	.15
( )	1	220 kΩ (red-red-yellow)	1-29	R2	.15
CONTROLS					
( )	1	25 kΩ	10-173	R8	1.25
( )	1	500 kΩ	10-946	R3	1.00
CAPACITORS, Disc					
( )	1	.005 μF	21-27	C2	.15
( )	1	.01 μF, 100V	21-176	C3	.15
( )	1	.01 μF	21-16	C1	.15
( )	1	.1 μF	21-95	C4	.25
( )	1	.2 μF	21-99	C5	.40



QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.	PRICE Each.
CONNECTOR-JACK-KNOB				
( ) 1	Battery connector	432-798		.15
( ) 1	Phone jack	436-3		.40
( ) 1	Knob	462-138		.60
METAL PARTS				
( ) 1	Front panel	203-1671-1		1.05
( ) 1	L bracket	204-102		.30
( ) 1	Battery bracket	204-2068		.85

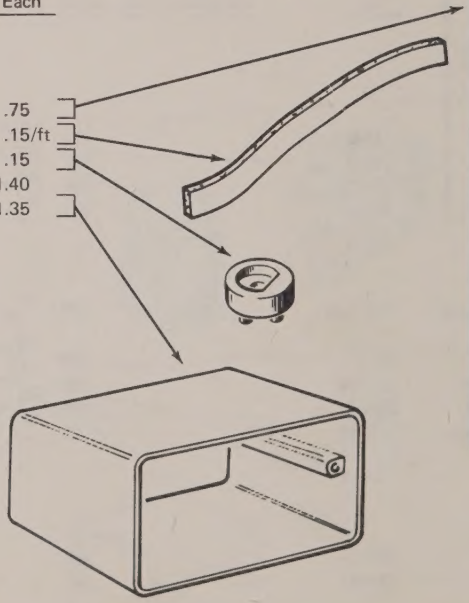


	QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.	PRICE Each
HARDWARE					
#6 Hardware					
( )	4	6-32 x 1/4" screw	250-56		.05
( )	7	6-32 nut	252-3		.05
( )	6	#6 lockwasher	254-1		.05
( )	1	#6 solder lug	259-1		.05
Other Hardware					
( )	2	#4 x 3/8 self-tapping screw	250-186		.05
( )	2	Control nut	252-7		.05
( )	2	Control flat washer	253-10		.05
( )	2	Control lockwasher	254-4		.05
( )	1	8-32 x 1/4" setscrew	250-43		.05
WIRE					
( )	1	Black wire	344-90		.05
( )	1	Red wire	344-92		.05
TRANSISTORS					
( )	1	2N5249A	417-213	Q3	1.30
( )	2	MPSA20	417-801	Q1,Q2	.25

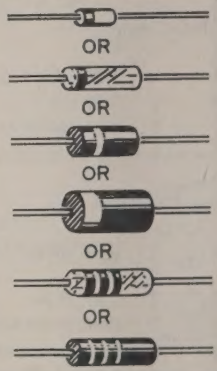


MISCELLANEOUS

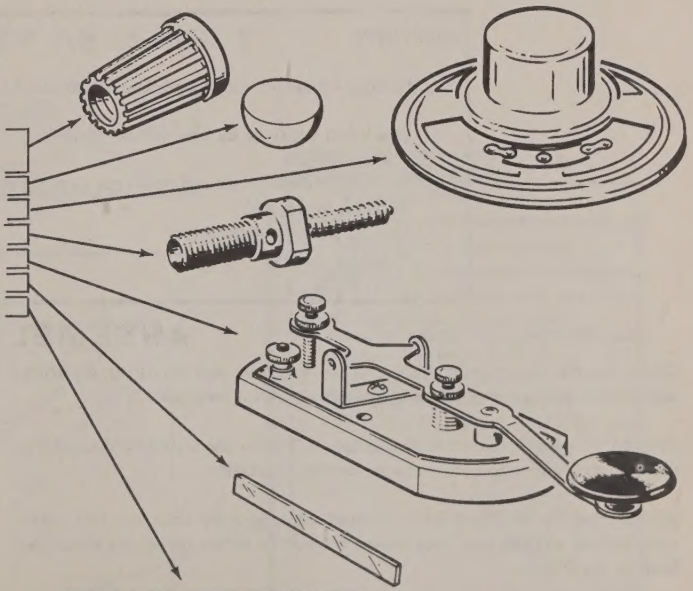
QTY.	DESCRIPTION	PART No.	CIRCUIT Component No.	PRICE Each
( ) 1	Diode	57-27	D1	.75
( ) 1	Gasket	73-39		.15/ft
( ) 4	Binding post bushing	75-17		.15
( ) 1	Circuit board	85-1609-2		1.40
( ) 1	Cabinet	95-98		1.35



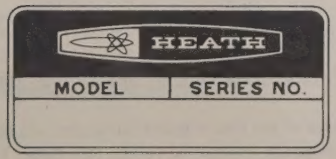
NOTE: HEATH PART NUMBERS ARE STAMPED ON MOST DIODES.



QTY.		DESCRIPTION	PART No.	CIRCUIT Component No.	PRICE Each
Miscellaneous (cont'd.)					
( )	1	Black binding post cap	100-16-2		.15
( )	1	Red binding post cap	100-16-18		.15
( )	4	Plastic foot	261-43		.15
( )	1	Speaker	401-163		2.10
( )	2	Binding post base	427-3		.15
( )	1	Key	441-2		2.55
( )	2	Trim strip	390-1167		.15
( )	1	Blue and white label	391-34		.15
( )	1	Parts Order Form	597-260		
( )	1	Kit Builders Guide	597-308		
( )	1	Manual (See front cover for part number.)			
		Solder (Additional 3' rolls of solder, #331-6, can be ordered for 25 cents each.)			



The above prices apply only on purchases from the Heath Company where shipment is to a U.S.A. destination. Add 10% (minimum 25 cents) to the price when ordering (Michigan residents add 4% sales tax) to cover insurance, postage, and handling. Outside the U.S.A. parts and service are available from your local Heathkit source and will reflect additional transportation, taxes, duties, and rates of exchange.



BATTERY

You should purchase the following battery at this time for use in your kit:

One 9-volt transistor battery, NEDA #1604.

Representative manufacturers and their type numbers are:

Eveready #216, PP3
Mallory #TR-146X (long life)
Hellesens #410
Varta #438

ASSEMBLY NOTES

Before you start to assemble this kit, be sure you have read the wiring, soldering, and step-by-step assembly information in the "Kit Builders Guide."

Position all parts as shown in the Pictorials. Follow the instructions carefully, and read the entire step before you perform the operation.

NOTE: Your circuit board has a lettered side and a foil side. You will install parts on the lettered side (side having the outline of the parts) and solder the leads to the foil side.

Resistors will be called out by their resistance value (in Ω or kΩ) and color code.

Capacitors will be called out by their capacitance value (in μF) and type (disc).

Due to the small foil area around some of the circuit board holes, you will have to use care to prevent solder bridges between adjacent foil areas. (See Page 11 of your Kit Builders Guide). Use only a minimum amount of solder and a 25-watt to 35-watt soldering iron with a small tip. (See Figure 1). Allow the soldering iron to reach operating temperature, and then apply it long enough for the solder to flow freely and make a good connection.

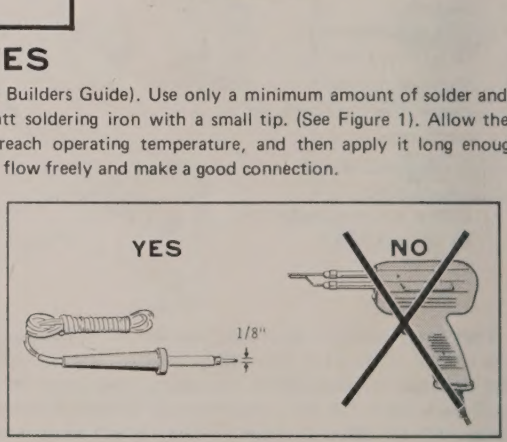


Figure 1

STEP-BY-STEP ASSEMBLY

START

NOTE: Be sure you have checked the parts in the "Parts List" and have read the "Assembly Notes" (on the preceding page) before you perform the following steps.

Position the circuit board lettered side up as shown in Pictorial 1. Then perform the following steps.

( ) R7: 33 kΩ (orange-orange-orange).

( ) R6: 2200 Ω (red-red-red).

( ) R2: 220 kΩ (red-red-yellow).

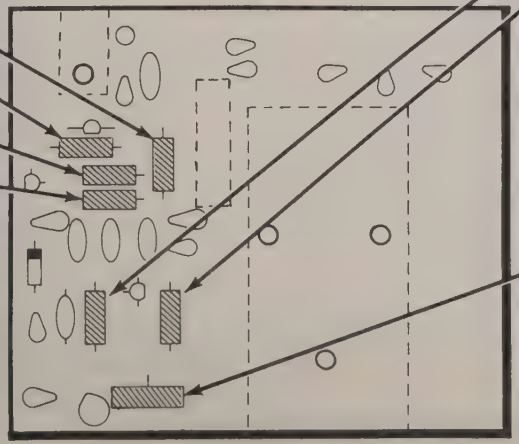
( ) R1: 10 kΩ (brown-black-orange).

SAFETY WARNING: Avoid eye injury when you cut off excess lead lengths. Hold the leads so they cannot fly toward your eyes.

( ) Solder the leads to the foil and cut off the excess lead lengths.

FOR GOOD SOLDERED CONNECTIONS, YOU MUST KEEP THE SOLDERING IRON TIP CLEAN...

WIPE IT OFTEN WITH A DAMP SPONGE OR CLOTH.



PICTORIAL 1

CONTINUE

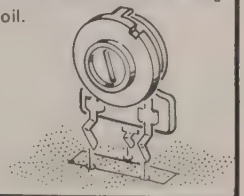
( ) R4: 68 kΩ (blue-gray-orange).

( ) R5: 5600 Ω (green-blue-red).

NOTE: In the following step save four cutoff resistor leads for use later.

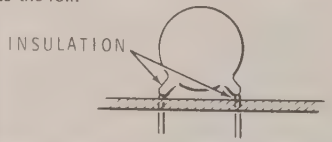
( ) Solder the leads to the foil and cut off the excess lead lengths.

( ) R3: 500 kΩ control. Solder the lugs to the foil.



START

NOTE: When you install disc capacitors, do not push the insulated portion of the leads into the circuit board holes. This could make it difficult to solder the leads to the foil.



( ) C5: .2 µF disc.

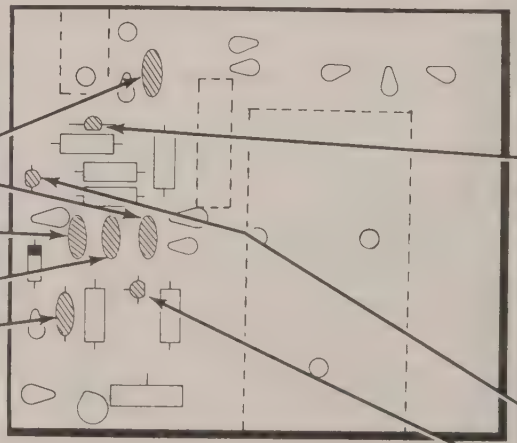
( ) C4: .1 µF disc.

( ) C3: .01 µF, 100V disc.

( ) C2: .005 µF disc.

( ) C1: .01 µF disc.

( ) Solder the leads to the foil and cut off the excess lead lengths.

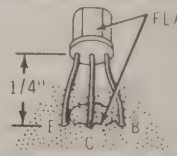


PICTORIAL 2

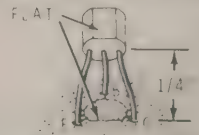
CONTINUE

IMPORTANT: Install transistors in the manner shown. First line up the flat of the transistor with the outline of the flat on the circuit board. Then insert the transistor leads into their correct holes, indicated by E, C, and B. Push the transistor down to 1/4" above the circuit board. Solder the leads to the foil and cut off the excess lead lengths.

( ) Q3: 2N5249A (#417-213).



( ) Q1: MPSA20 (#417-801).

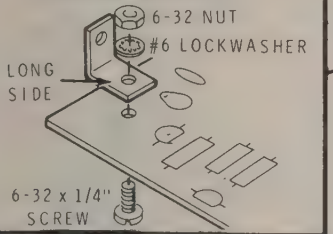


( ) Q2 MPSA20 (#417-801).

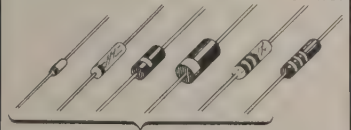
( ) Check to be sure that all transistor leads have been soldered to the foil and the excess lead lengths cut off.

START

( ) Mount the long side of the L bracket to the lettered side of the circuit board. Use a 6-32 x 1/4" screw, a #6 lockwasher, and a 6-32 nut. Do not overtighten the screw.

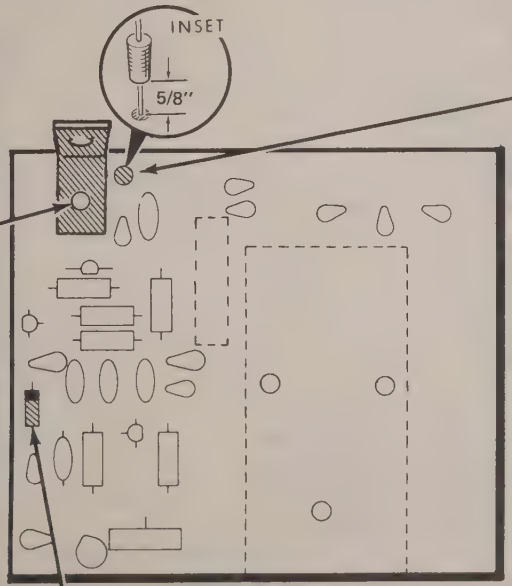


NOTE: DIODES MAY BE SUPPLIED IN ANY OF THE FOLLOWING SHAPES. ALWAYS POSITION THE BANDED END AS SHOWN ON THE CIRCUIT BOARD.

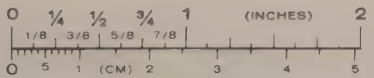


( ) D1: 1N2071 (#57-27).

( ) Solder the leads to the foil and cut off the excess lead lengths.

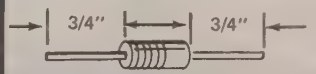


PICTORIAL 3



CONTINUE

R9: 8200 Ω (gray-red-red). Cut both ends of this resistor to a length of 3/4". Then mount the resistor with the body 5/8" above the circuit board as shown in the inset. Solder the lead to the foil. The other end of the resistor will be connected later.



CIRCUIT BOARD CHECKOUT

Carefully inspect the circuit board for the following conditions.

( ) There are 12 unused component holes in the circuit board and 3 unused larger holes.

( ) Unsoldered connections.

( ) "Cold" solder connections.

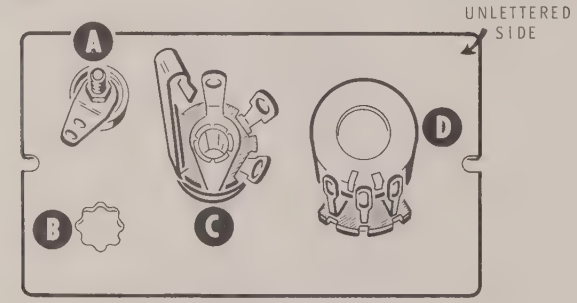
( ) Solder bridges between foil patterns.

( ) Protruding leads. No leads or lugs should be longer than 1/8".

( ) Transistors for the proper type and installation.

( ) Diodes for the correct position of the banded end.

FINISH



PICTORIAL 4

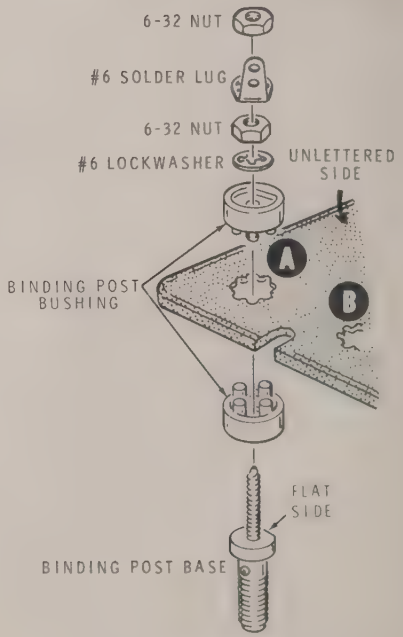
FRONT PANEL PARTS MOUNTING

Refer to Pictorial 4 for the following steps.

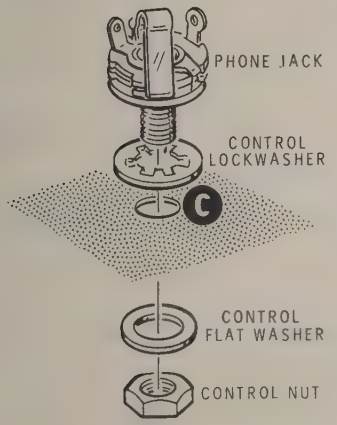
( ) Refer to Detail 4A and install a binding post base at A on the lettered side of the front panel. Use two binding post bushings, a #6 lockwasher, a #6 solder lug, and two 6-32 nuts. Position the flat side of the binding post base as shown. Tighten the first nut securely before you install the solder lug and second nut on the binding post. Make sure the binding post base is seated in the binding post bushing.

( ) Refer to Detail 4B and mount a phone jack at C. Use a control lockwasher, a control flat washer, and a control nut. Position the phone jack contacts as shown in Pictorial 4 before you tighten the control nut.

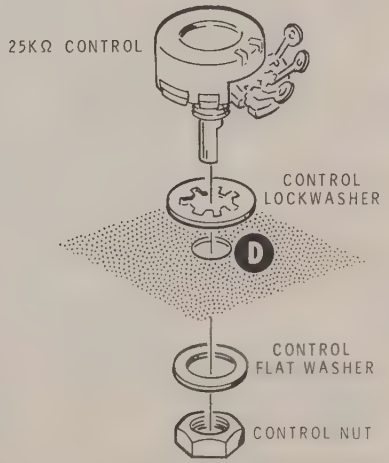
( ) Refer to Detail 4C and mount the 25 kΩ control at D. Use a control lockwasher, a control flat washer, and a control nut. Position the three lugs as shown in Pictorial 4 before you tighten the control nut.



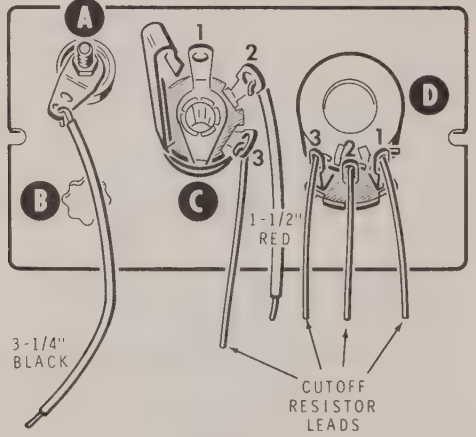
Detail 4A



Detail 4B



Detail 4C



PICTORIAL 5

Refer to Pictorial 5 for the following steps.

( ) Locate the four resistor leads you saved earlier.

NOTE: In the following steps, (NS) means not to solder until later. "S" with a number, such as (S-1), means to solder the connection. The number following the "S" tells how many wires are at the connection.

( ) Connect a lead to control D lug 1 (S-1).

( ) Connect a lead to control D lug 2 (S-1).

( ) Connect a lead to control D lug 3 (S-1).

( ) Connect a lead to phone jack C lug 3 (S-1).

To prepare a wire, as in the next step, cut it to the indicated length and remove 1/4" of insulation from each end. Then twist the strands together and melt a small amount of solder on the bare wire ends to hold the strands together. This is called tinning the lead.

( ) Prepare a 1-1/2" length of red stranded wire.

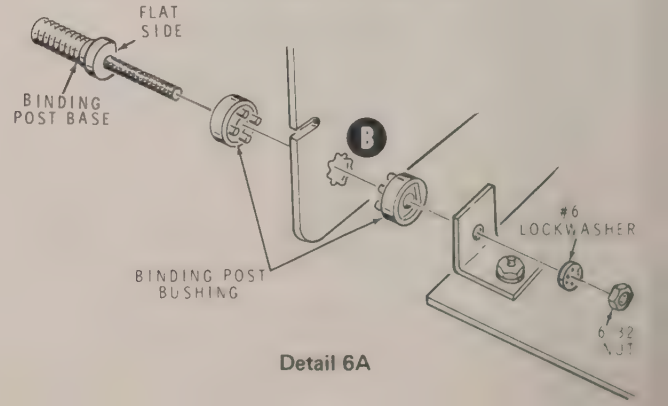
( ) Connect this wire to phone jack C lug 2 (S-1).

Bend the five leads as shown. The ends of these leads will be connected later.

( ) Prepare a 3-1/4" length of black stranded wire.

( ) Connect this 3-1/4" wire to the solder lug at A (S-1).

The front panel will now be mounted to the circuit board.



Detail 6A

Refer to Pictorial 6 (fold-out from this page) for the following steps.

( ) Insert the free end of the lead coming from the phone jack, lug 3, into circuit board hole E (NS).

( ) Insert the free end of the lead coming from the phone jack, lug 2, into circuit board hole F (NS).

( ) Insert the leads coming from control D lug 1, 2, and 3 into circuit board holes D, C, and B respectively (NS).

NOTE: Make sure the front panel is parallel to the front edge of the circuit board before you solder the leads to the foil. The distance between the bottom edge of the front panel and the foil side of the circuit board should also be the same along the entire length of the circuit board.

( ) Refer to Detail 6A and install a binding post base at B on the front panel. Use two binding post bushings. Push the binding post base through the hole in the L bracket. Use a #6 lockwasher and a 6-32 nut. Tighten the nut securely.

( ) Solder the five leads to the foil of the circuit board and cut off the excess lead lengths.

( ) Connect the free end of vertical mounted resistor R9 (8200 Ω, gray-red-red) to the phone jack, lug 1 (S-1).

( ) Insert the free end of the wire coming from the solder lug at A on the front panel to hole A on the circuit board (S-1).

( ) Connect the red wire coming from the battery connector to circuit board hole "+" (S-1).

( ) Connect the black wire coming from the battery connector to circuit board hole "–" (S-1).

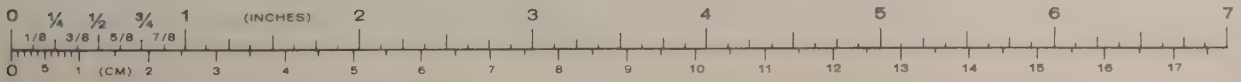
( ) Cut off the excess wire lengths.

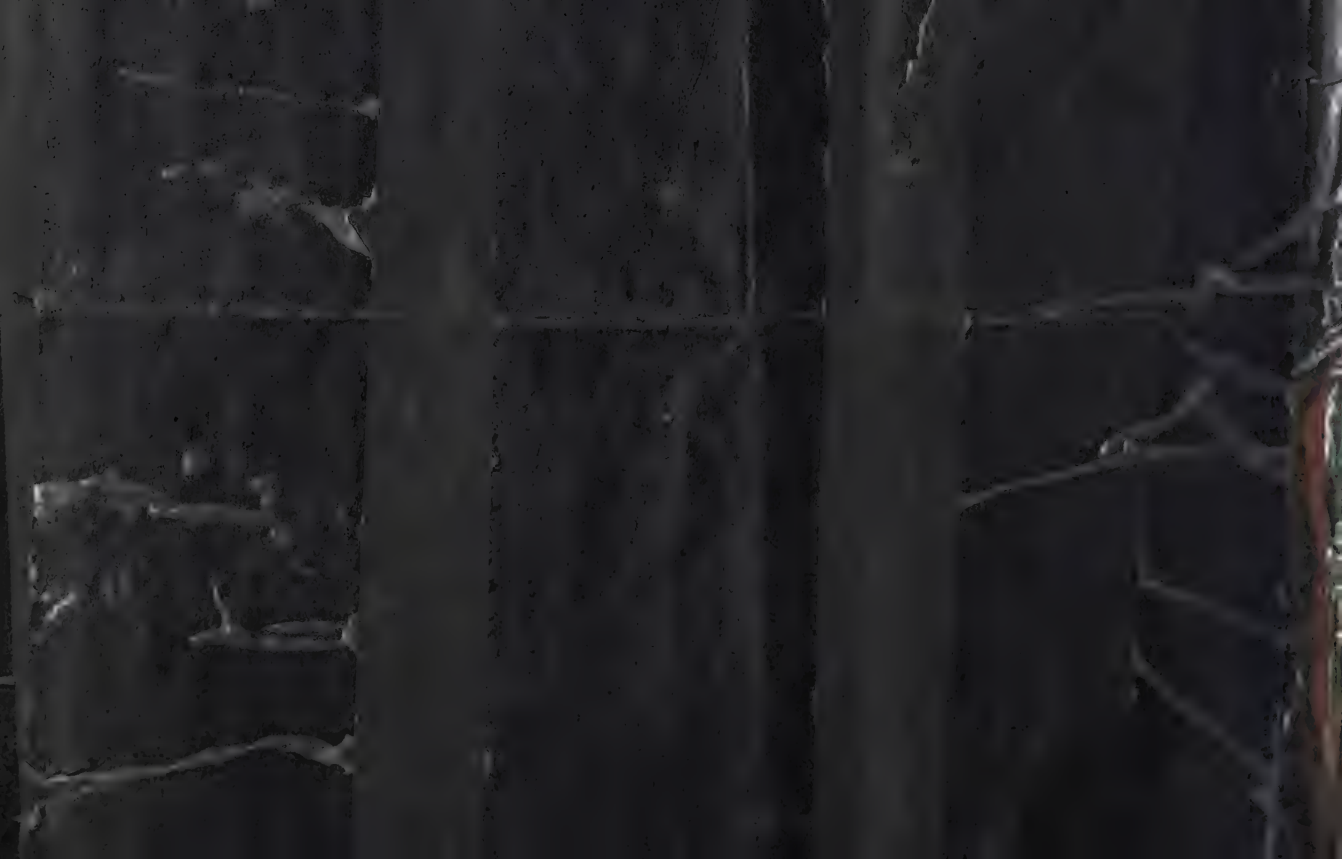
Cut four 1" pieces of foam gasket.

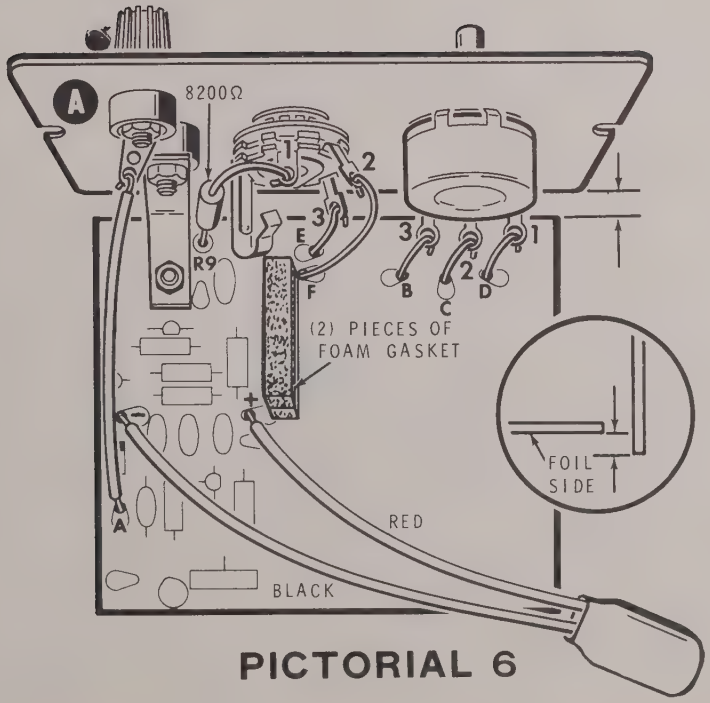
( ) Peel the paper backing from one piece of foam gasket. Press this piece down against the circuit board at the location shown. Peel the paper backing from another piece of foam gasket and press it down against the first piece.

( ) Prepare the following lengths of stranded wire:

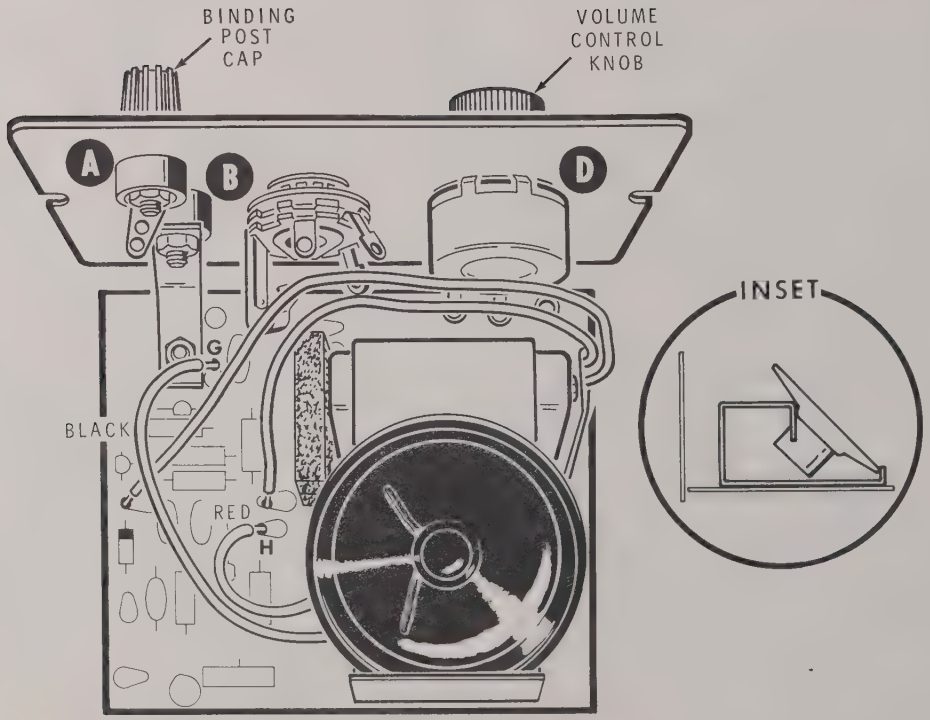
3-1/4" black
2" red



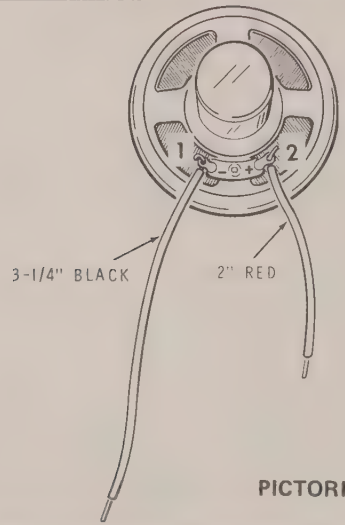



A
8200Ω
R9
1
2
3
E
F
3
2
1
B
C
D
(2) PIECES OF
FOAM GASKET
FOIL
SIDE
RED
BLACK
A

PICTORIAL 6



PICTORIAL 8



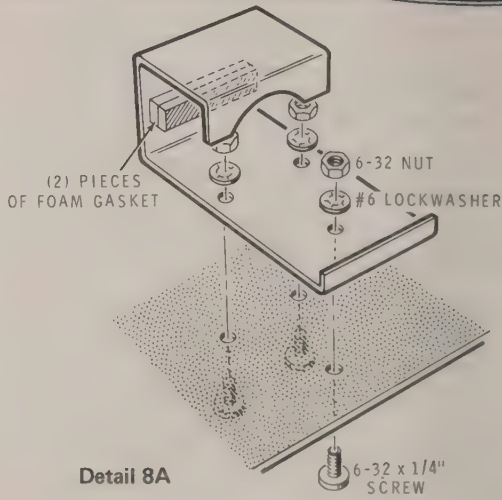
PICTORIAL 7

CAUTION: Be careful when you solder to the speaker so that no solder drops on the speaker cone.

( ) Refer to Pictorial 7 and connect a 3-1/4" black wire to lug 1 of the speaker (S-1).

( ) Connect a 2" red wire to lug 2 of the speaker (S-1).

( ) Peel the paper backing from a piece of foam gasket.



Detail 8A

( ) Refer to Detail 8A and press the piece of foam gasket to the inside of the battery bracket as shown.

( ) Peel the paper backing from the remaining 1" piece of foam gasket.

( ) Press this piece down against the first piece.

( ) Then mount the battery bracket on the circuit board using the three remaining holes. Use 6-32 x 1/4" screws, #6 lockwashers, and 6-32 nuts.

( ) Plug the battery connector onto the 9-volt battery (not supplied).

( ) Install the battery in the battery bracket and push it up against the two pieces of foam gasket on the circuit board.

NOTE: Be careful so you do not damage the speaker cone in the following step.

( ) Refer to Detail 8B and the inset drawing on Pictorial 8 and mount the speaker on the battery bracket. Push the magnet assembly under the upper flange of the battery bracket. Push the edge of the speaker frame down in front of the lower flange of the battery bracket so the speaker is held firmly in place. Make sure that the speaker lugs do not make contact with the battery bracket.

Refer to Pictorial 8 (fold-out from Page 16) for the following steps.

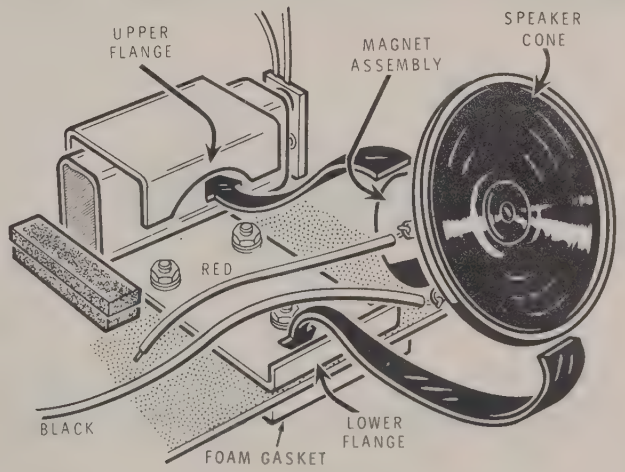
( ) Insert the free end of the red wire coming from speaker lug 2 in circuit board hole H (S-1).

( ) Insert the free end of the black wire coming from speaker lug 1 in circuit board hole G (S-1).

( ) Cut off the excess wire lengths.

( ) Install the black binding post cap on binding post B, and the red cap on A.

( ) Check the knob to see if there is a setscrew in it. If not, install the 8-32 x 1/4" setscrew in it. If a setscrew is already in the knob, discard the loose 8-32 x 1/4" setscrew packed in the kit.

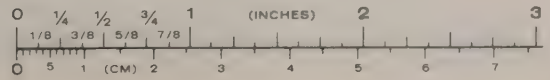


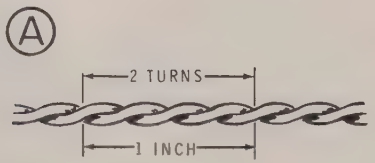
Detail 8B

( ) Install the knob on the Volume control shaft at D.

( ) Cut a 2" piece of foam gasket.

( ) Peel the backing from the foam gasket and press it against the foil side of the circuit board at the location shown in Detail 8B.





Detail 9A

KEY ASSEMBLY

( ) Cut the remaining lengths of stranded wires to the same length.

( ) Remove 1/2" of insulation from each wire end and twist together the small strands of wire. Then apply a small amount of solder to the ends to hold the strands together.

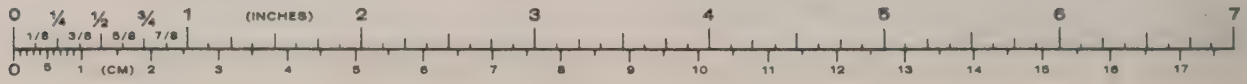
( ) Refer to Detail 9A and gather the black and the red wires and twist them together approximately two turns per inch.

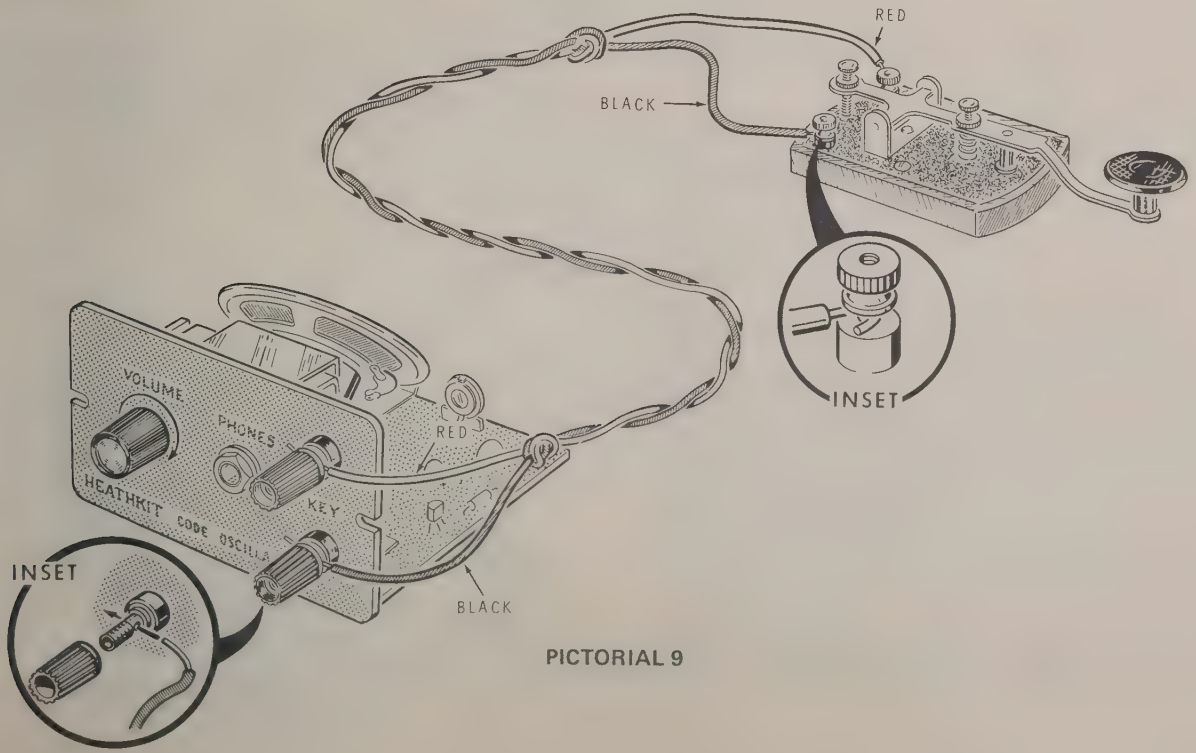
( ) Tie a knot two inches from each end of the twisted pair of wires.

( ) Refer to Pictorial 9 and connect the red wire to the binding post base with the red cap.

( ) Connect the black wire to the binding post base with the black cap.

( ) Connect the remaining ends of the twisted pair of wires to the key as shown.





PICTORIAL 9

INITIAL TEST

NOTE: If the unit does not perform properly in the following test, refer to the "In Case of Difficulty" section of the Manual.

Refer to Pictorial 10 for the following steps.

( ) Turn the TONE and VOLUME controls to their centers of rotation.

( ) Close (depress) the key with one hand. You should hear a tone. Use the other hand to adjust the TONE and VOLUME controls. The highest-pitched tone will be heard with the TONE control set fully clockwise (see inset). The loudness will increase as you rotate the VOLUME control clockwise.

This completes the "Initial Test."

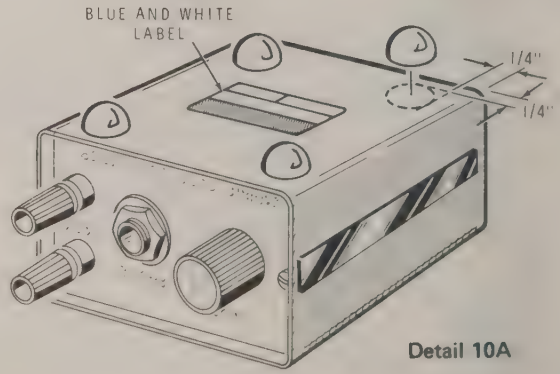
FINAL ASSEMBLY

( ) Refer to Pictorial 10 and install the circuit board and front panel assembly in the cabinet. Install two #4 x 3/8 self-tapping screws through the remaining two holes in the front panel and into the inside of the cabinet. Press the battery connector wires down to clear the cabinet.

( ) Peel the backing from two trim strips. Then press one trim strip against the smooth area in the center of each cabinet side.

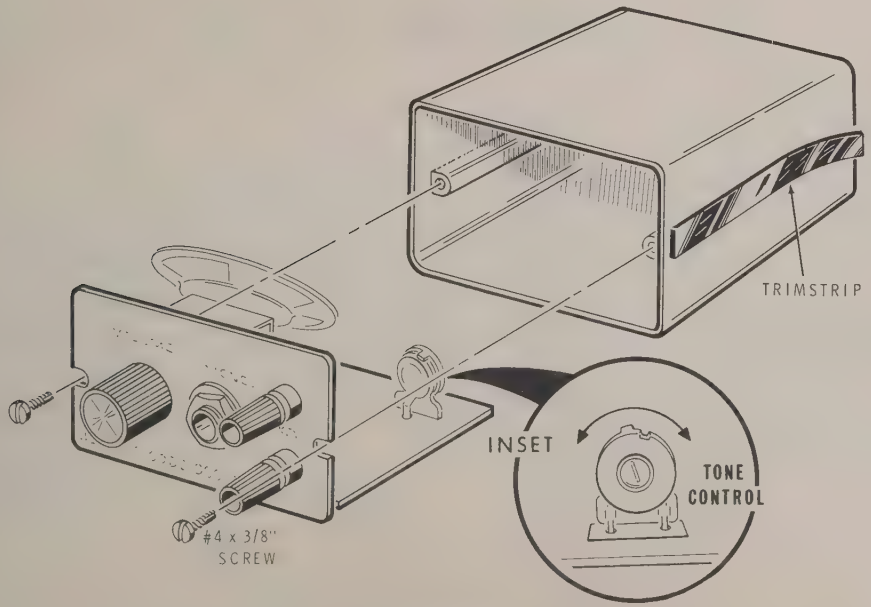
( ) Refer to Detail 10A and install a plastic foot near each corner on the bottom of the cabinet. Remove the paper backing; then press the foot onto the cabinet in the position shown.

( ) Carefully peel away the backing paper from the blue and white identification label. Then press the label onto the bottom of the cabinet. Be sure to refer to the numbers on this label in any communications you have with the Heath Company about this kit.



Detail 10A

This completes the assembly of your Code Oscillator.



PICTORIAL 10

ADJUSTMENT

Refer to Figure 2 for the following step.

( ) Loosen the locknuts and adjusting screws of the key at Y and Z by turning counterclockwise. NOTE: The locknuts may be very tight.

( ) Tighten the adjusting screw at Y until 3 thicknesses of ordinary typing paper, or a common business card, may be withdrawn from between the key contacts at AA without friction. Tighten the locknut at Y. This key contact spacing is approximate and may be adjusted to conform to your keying preference.

( ) Adjust the screw at Z to provide the key "stiffness" desired. Retain the adjustment by tightening the locknut.

NOTE: For best results, secure the key by attaching it to a block of wood (not supplied) as shown in Figure 2. Ream out the two holes visible from the bottom of the key. Then attach the key with two screws.

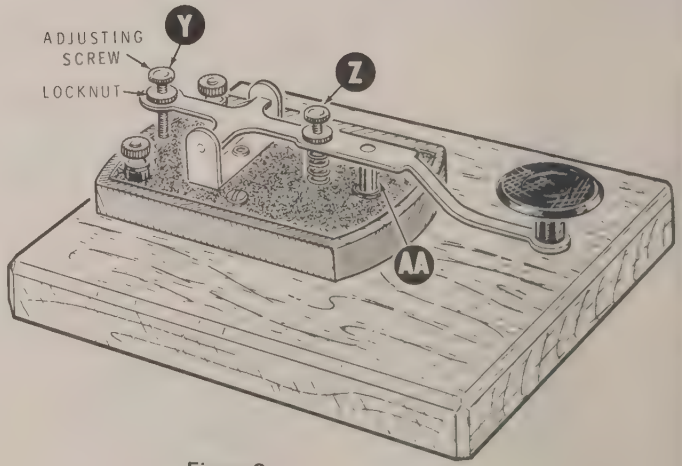


Figure 2

OPERATION AND APPLICATIONS

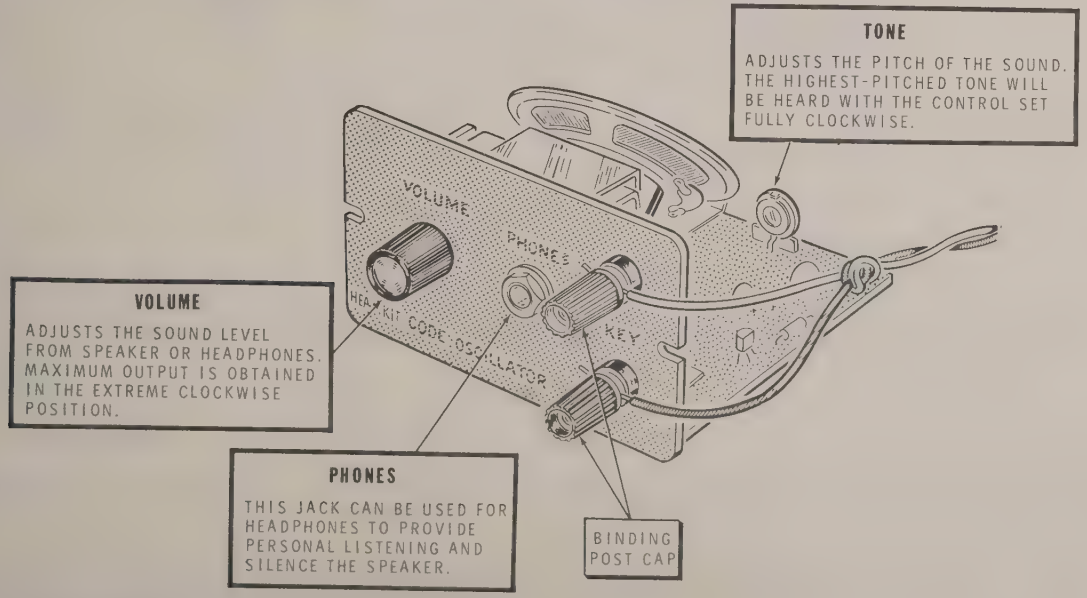

TONE
ADJUSTS THE PITCH OF THE SOUND. THE HIGHEST-PITCHED TONE WILL BE HEARD WITH THE CONTROL SET FULLY CLOCKWISE.
VOLUME
ADJUSTS THE SOUND LEVEL FROM SPEAKER OR HEADPHONES. MAXIMUM OUTPUT IS OBTAINED IN THE EXTREME CLOCKWISE POSITION.
PHONES
THIS JACK CAN BE USED FOR HEADPHONES TO PROVIDE PERSONAL LISTENING AND SILENCE THE SPEAKER.
BINDING POST CAP
VOLUME
PHONES
KEY

Figure 3

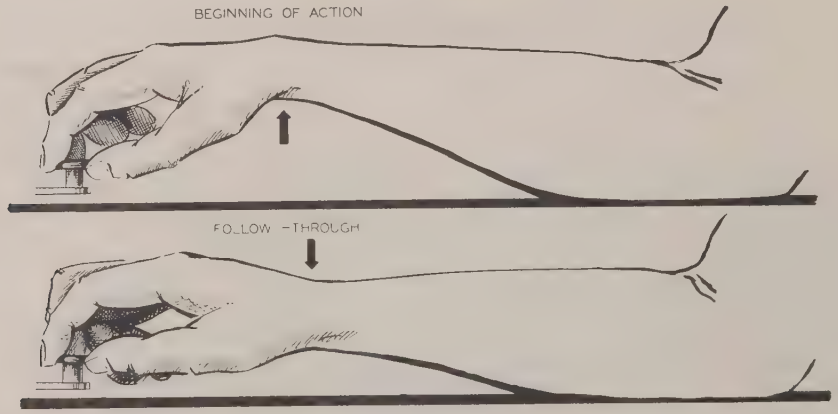
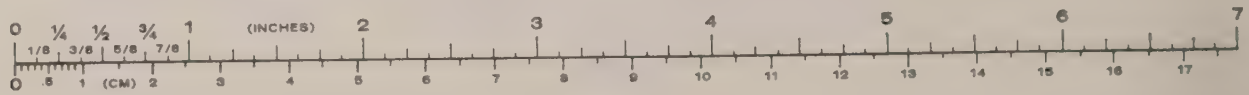


Figure 4

Figure 4 shows the suggested position for the hand on the key knob. Work the key with simultaneous hand and wrist movements. The use of hand movements alone tends to create muscle tension and will soon become tiring. Try and keep your hand and arm muscles as relaxed as possible.



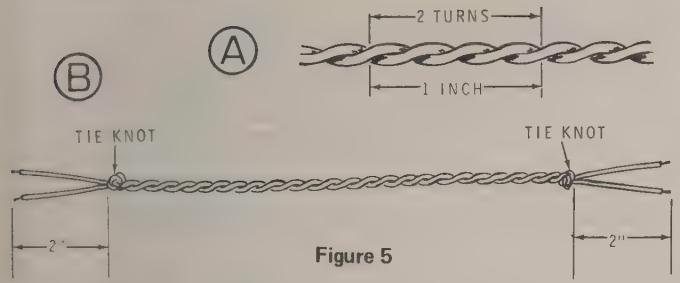


Figure 5

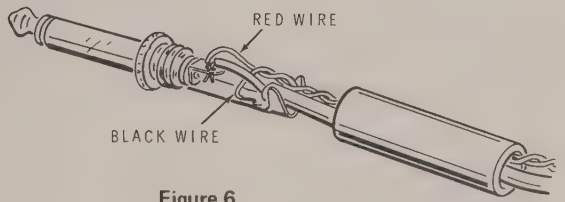


Figure 6

SIDETONE OSCILLATOR

If you wish, you may use this Code Oscillator as a sidetone oscillator with any transmitter using grid-block keying, or other types of keying where a negative (bias) voltage is shorted to ground to key the transmitter.

To use the Code Oscillator as a sidetone oscillator, proceed as follows:

Locate and prepare the following lengths of insulated stranded wire (not supplied).

2' black
2' red

( ) Remove 1/4" of insulation from each wire end. Twist together the small strands of wire at the end of each wire. Then apply a small amount of solder to the ends of each wire to hold the separate strands together.

( ) Refer to Figure 5 and gather the black and the red wires and twist them together approximately two turns per inch.

( ) Tie a knot two inches from each end of the twisted pair of wires.

( ) Insert the black wire in circuit board hole GND (S-1).

( ) Insert the red wire in circuit board hole ST (S-1).

( ) As shown in Figure 6, connect the remaining ends of the twisted pair of wires to the key plug you normally need with your transmitter.

( ) Insert the key plug into the key jack of your transmitter. When you close the key you can now monitor the transmitted signal.

INTERNATIONAL MORSE CODE

A	·–	didah	N	–·	dahdit
B	–···	dahdididit	O	–––	dahdahdah
C	–·–·	dahdidahdit	P	·––·	didahdahdit
D	–··	dahdidit	Q	––·–	dahdahdidah
E	·	dit	R	·–·	didahdit
F	··–·	dididahdit	S	···	dididit
G	––·	dahdahdit	T	–	dah
H	····	dididididit	U	··–	dididah
I	··	didit	V	···–	dididididah
J	·–––	didahdahdah	W	·––	didahdah
K	–·–	dahdidah	X	–··–	dahdididah
L	·–··	didahdidit	Y	–·––	dahdidahdah
M	––	dahdah	Z	––··	dahdahdidit

1	·––––	didahdahdahdah	6	–····	dahdididit
2	··–––	dididahdahdah	7	––···	dahdahdidit
3	···––	didididahdah	8	–––··	dahdahdahdit
4	····–	dididididah	9	––––·	dahdahdahdah
5	·····	dididididit	0	–––––	dahdahdahdahdah

Period	·–·–·–	didahdidahdidah
Comma	––··––	dahdahdididahdah
Question Mark	··––··	dididahdahdidit
Error	·····––·	dididididididit
Double Dash	–···–	dahdidididah
Wait	·–···	didahdididit
End of Message	·–·–·	didahdidahdit
Invitation to Transmit	–·–	dahdidah
End of Work	···–·–	didididahdidah
Fraction Bar	–··–·	dahdididahdit

Figure 7

LEARNING THE CODE

The Continental (International) Morse code is a language of sound. Although it can be recorded on paper, it is most often sent and received as sound. Thus if at all possible the code should be learned as sound. The "sound" of the letter "A" in code, for example, should implant the letter "A" directly into the mind of the receiving operator. If the code were learned from a printed page, the operator would first have to convert the sound of "A" in code to a "dot-dash" symbol, as shown on a printed page; and then he would have to convert the symbol into the letter "A" in his mind. This would consume more time and make it much more difficult to acquire code speed.

You can best learn the Morse code by listening to code-teaching records or cassette tapes. These are available from the Heath Company. You can also have a member of the family, or a friend, send a few letters at a time to you with the Code Oscillator. A letter should be called out (pronounced) and then keyed. These small groups of letters can be sent, with pauses after each letter, until you learn them. In similar fashion, additional groups of letters can then be learned. During this learning process, the selection of the letters for these first groups should be such that simple words can be formed. This will tend to speed up learning.

The person sending the code should use the Code Chart, Figure 7, as his text. First, the sender should concentrate on proper formation of the characters and smoothness of keying. Speed in sending will come later when the characters become more familiar.

The code symbols are designated in speech by operators as "dit" and "dah" instead of "dot" and "dash." Thus, the letter A (• ▬) is "didah," the "t" being dropped in such combinations. The "di" sound should be staccato. The number "5" (• • • • •) in spoken code language should sound like a machine-gun burst: "dididididit." Each "dah" should be stressed equally, with one being no shorter or longer than another.

Many operators recommend that as you go about your daily work, or as the opportunity presents itself, you spell out the names of common objects around you in "didah" language, either silently to yourself or aloud. Any characters that seem to be especially difficult should be given special attention and repetition until they no longer remain a problem.

If you have a radio receiver capable of receiving amateur radio station W1AW (the headquarter's station of the American Radio Relay League, 225 Main Street, Newington, Connecticut, 06111) you will find that it transmits code practice twice nightly. The station's schedule as to the time and frequencies can be secured from the American Radio Relay League magazine "QST," from a local ham, or by sending a postcard of inquiry direct to the address given above. You might also wish to inquire about the League publication "Learning the Radio Telegraph Code," which contains practice material for both home study and classroom use.

Determination is required to learn the code, just as in learning to type by touch. Only practice and more practice will produce results. Your immediate objective may well be an amateur radio license. For this, the Federal Communications Commission requires that you demonstrate your ability to both send and receive code in an acceptable manner at prescribed speeds. You will find this Code Oscillator an invaluable aid.

When you master the Morse code, you will have completed a very important step towards obtaining your amateur radio license. After you have completed the theory requirements, you will soon be able to enjoy a very fascinating hobby, Ham Radio.

IN CASE OF DIFFICULTY

1. Recheck the wiring. Trace each lead and wire in colored pencil on the Pictorial as it is checked. It is frequently helpful to have a friend check your work. Someone who is not familiar with the unit may notice something consistently overlooked by the builder.

2. About 90% of the kits that are returned for repair are defective due to poor connections and soldering. Therefore, many troubles can be eliminated by reheating all connections to make sure that they are soldered as illustrated in the Soldering section of the Kit Builders Guide.

3. Check the values of the component parts. Be sure that the proper parts have been wired into each circuit, as shown in the Pictorials and as called out in the wiring instructions.

4. Check for bits of solder, wire ends, or other foreign matter which may be lodged in the wiring or components, causing a short circuit.

5. Tone variation, or a warbling note during keying, is usually caused by poo contact in the keying circuit or at the key contacts themselves. The key contacts may be cleaned by drawing a strip of emery paper between the contacts with very slight pressure on the key knob. Turn the strip o emery paper over and draw it through a second time to clean the othe key contact.

6. Little or no tone output indicates that the 9-volt battery may be weak.

7. The complete absence of tone indicates that the key contacts are dirty o not closing.

8. A continuous tone may indicate closed KEY contacts or a short circuit i the key cable or other parts of the keying circuit.

NOTE: In an extreme case where you are unable to resolve a difficulty, refer t the "Customer Service" information inside the rear cover of the Manual. You Warranty is located inside the front cover.

Troubleshooting Chart

PROBLEM	POSSIBLE CAUSE
DC voltages low or absent.	1. Weak or defective battery. 2. Wires from battery connector to circuit board interchanged.
No sound.	1. Phone jack incorrectly wired. 2. Check voltages on transistors Q1, Q2, and Q3. 3. Diode D1 backwards. 4. Telegraph key not wired. 5. Speaker terminals shorted together or to battery bracket. 6. Phone jack shorted to speaker bracket.
Tone control has no effect.	1. Control R3 shorted (solder bridge).
Tone varies when Volume control is rotated (only when headphones are used).	1. The front panel is shorted to circuit board ground.
Sound from speaker when key is not closed and unit is used as sidetone oscillator.	1. Diode D1 wired backwards. 2. There is a positive voltage present at ST on the circuit board. Code Oscillator should only be used with transmitter using negative voltage grid-block keying. 3. Wires in plug interchanged.

SPECIFICATIONS

Mode of Operation	Audible tone from speaker or headphones (600 ohms or greater).
Tone Frequency	Typically 200-850 Hz (adjustable).
Controls	Volume control. Tone control (internally).
Front Panel Connections	Key jack (key furnished). Phone jack.
Speaker	45 ohms, permanent magnet type.
Transistors	2 – MPSA20. 1 – 2N5249A.
Battery Required (not supplied).	1 – 9-volt transistor battery (NEDA #1604). See the note on Page 8.
Sidetone Oscillator	Grid-block keying type transmitters. Maximum -400V DC.

Color	Dark green and gray wrinkle finish.
Dimensions	4-1/8" wide x 2-5/8" high x 4-3/8" deep.
Net weight (including key and battery)	12 oz.

The Heath Company reserves the right to discontinue products and to change specifications at any time without incurring any obligations to incorporate new features in products previously sold.

CIRCUIT DESCRIPTION

The key is connected in series with the 9-volt battery. When the key is closed, the astable multivibrator; consisting of Q1, Q2, and associated components; produces a series of voltage pulses. These pulses are fed through audio filtering circuit C4, R8, and C5 to the base of the amplifier, Q3.

The 500 kΩ TONE control, R3, adjusts the rate of pulses per second from the astable multivibrator. The 25 kΩ VOLUME control, R8, adjusts the level of the voltage pulses fed to amplifier Q3.

When headphones are used, amplifier Q3 is disconnected from the circuit. (The contact between lugs 2 and 3 of the phone jack is broken.)

Diode D1 prevents any negative voltage from being fed back into the circuitry when the Code Oscillator is used as a side tone oscillator. The diode acts as an open circuit when a negative voltage is applied to the anode; the diode is reverse biased. When the key is closed, the diode will conduct and thus complete the electrical circuit. The diode is forward biased.

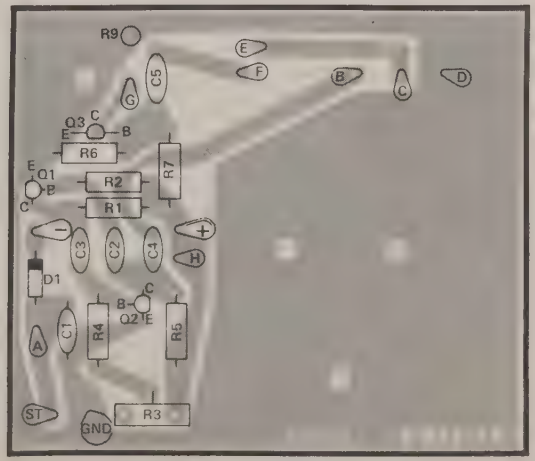
CIRCUIT BOARD X-RAY VIEW

NOTE: To find the PART NUMBER of a component for the purpose of ordering a replacement part:

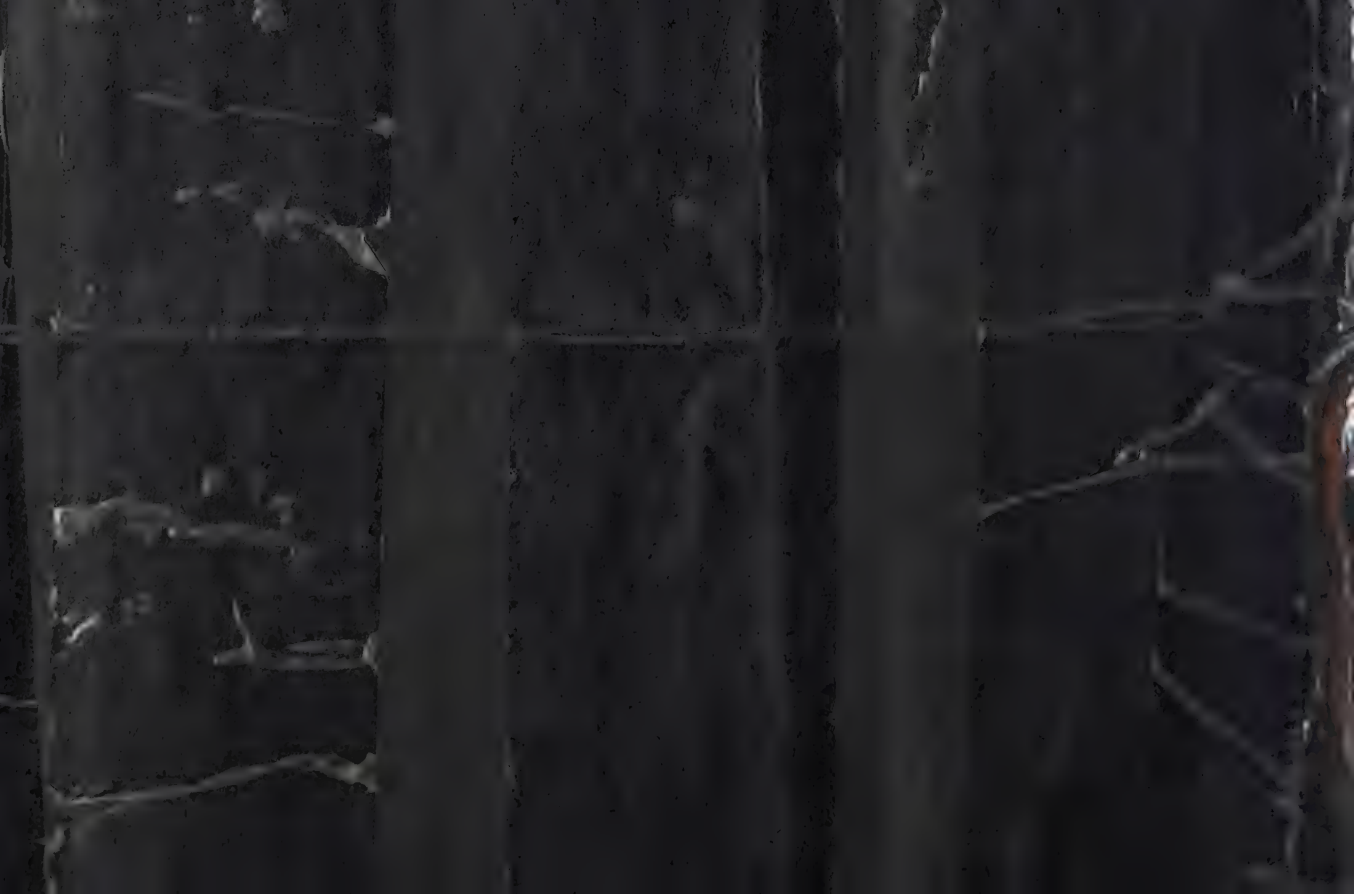
A. Find the circuit component number (R5, C3, etc.) on the "X-Ray View" or "Chassis Photograph."

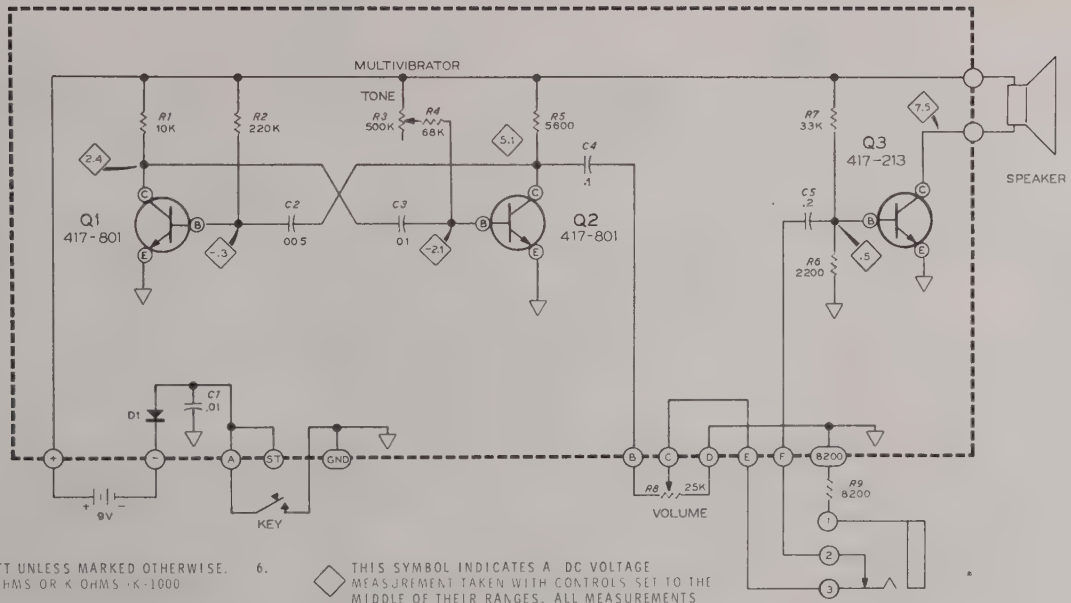
B. Locate this same number in the "Circuit Component Number" column of the "Parts List."

C. Adjacent to the circuit component number, you will find the PART NUMBER and DESCRIPTION which must be supplied when you order a replacement part.



CIRCUIT BOARD X-RAY VIEW
(Viewed from lettered side)





NOTES:

1. ALL RESISTORS ARE 1/2 WATT UNLESS MARKED OTHERWISE. RESISTOR VALUES ARE IN OHMS OR K OHMS (K=1000
2. ALL RESISTORS ARE 10% UNLESS MARKED OTHERWISE.
3. ALL CAPACITOR VALUES ARE IN μF UNLESS MARKED OTHERWISE.
4. REFER TO THE "CIRCUIT BOARD X-RAY VIEW" FOR THE PHYSICAL LOCATION OF PARTS.
5. ▽ THIS SYMBOL INDICATES A CIRCUIT BOARD GROUND.
6. ◇ THIS SYMBOL INDICATES A DC VOLTAGE MEASUREMENT TAKEN WITH CONTROLS SET TO THE MIDDLE OF THEIR RANGES. ALL MEASUREMENTS TAKEN WITH A HIGH INPUT IMPEDANCE VOLTMETER FROM THE POINT INDICATED TO CIRCUIT BOARD GROUND VOLTAGES MAY VARY AS MUCH AS ±20%
7. ALL MEASUREMENTS TAKEN WITH THE KEY CLOSED.
8. ○ THIS SYMBOL INDICATES A LETTERED CIRCUIT BOARD CONNECTION POINT

SCHEMATIC OF THE HEATHKIT®

CODE OSCILLATOR MODEL HD-1416

FOR PARTS REQUESTS ONLY

- Be sure to follow instructions carefully.
- Use a separate letter for all correspondence.
- Please allow 10 - 14 days for mail delivery time.

SEND TO:

HEATH COMPANY
BENTON HARBOR
MICHIGAN 49022
ATTN: PARTS REPLACEMENT

Phone (Replacement parts only):
616 982-3571

DO NOT WRITE IN THIS SPACE

INSTRUCTIONS

- Please print all information requested.
- Be sure you list the correct **HEATH** part number exactly as it appears in the parts list.
- If you wish to prepay your order, mail this card and your payment in an envelope. Be sure to include 10% (25¢ minimum, $3.50 maximum) for insurance, shipping and handling. Michigan residents add 4% tax.

  Total enclosed $_____
- If you prefer COD shipment, check the COD box and mail this card. COD ☐

NAME _____

ADDRESS _____

CITY _____

STATE _____ ZIP _____

The information requested in the next two lines is not required when purchasing nonwarranty replacement parts, but it can help us provide you with better products in the future.

Model # _____ Invoice # _____

Date Purchased _____ Location Purchased _____

LIST **HEATH** PART NUMBER	QTY.	PRICE EACH	TOTAL PRICE
TOTAL FOR PARTS			
HANDLING AND SHIPPING			
MICHIGAN RESIDENTS ADD 4% TAX			
TOTAL AMOUNT OF ORDER			

THIS FORM IS FOR U.S. CUSTOMERS ONLY — OVERSEAS CUSTOMERS SEE YOUR DISTRIBUTOR

CUSTOMER SERVICE

REPLACEMENT PARTS

Please provide complete information when you request replacements from either the factory or Heath Electronic Centers. Be certain to include the **HEATH** part number exactly as it appears in the parts list.

Replacement parts are maintained specifically to repair Heath products. Parts sales for other reasons will be declined.

ORDERING FROM THE FACTORY

Print all of the information requested on the parts order form furnished with this product and mail it to Heath. For telephone orders (parts only) dial 616 982-3571. If you are unable to locate an order form, write us a letter or card including:

- Heath part number.
- Model number.
- Date of purchase.
- Location purchased or invoice number.
- Nature of the defect.
- Your payment or authorization for COD shipment of parts not covered by warranty.

Mail letters to: Heath Company
Benton Harbor
MI 49022
Attn: Parts Replacement

Retain original parts until you receive replacements. Parts that should be returned to the factory will be listed on your packing slip.

OBTAINING REPLACEMENTS FROM HEATH ELECTRONIC CENTERS

For your convenience, "over the counter" replacement parts are available from the Heath Electronic Centers listed in your catalog. Be sure to bring in the original part and purchase invoice when you request a warranty replacement from a Heath Electronic Center.

TECHNICAL CONSULTATION

Need help with your kit? — Self-Service? — Construction? — Operation? — Call or write for assistance. you'll find our Technical Consultants eager to help with just about any technical problem except "customizing" for unique applications.

The effectiveness of our consultation service depends on the information you furnish. Be sure to tell us:

- The Model number and Series number from the blue and white label.
- The date of purchase.
- An exact description of the difficulty.
- Everything you have done in attempting to correct the problem.

Also include switch positions, connections to other units, operating procedures, voltage readings, and any other information you think might be helpful.

Please do not send parts for testing, unless this is specifically requested by our Consultants.

Hints: Telephone traffic is lightest at midweek — please be sure your Manual and notes are on hand when you call.

Heathkit Electronic Center facilities are also available for telephone or "walk-in" personal assistance.

REPAIR SERVICE

Service facilities are available, if they are needed, to repair your completed kit. (Kits that have been modified, soldered with paste flux or acid core solder, cannot be accepted for repair.)

If it is convenient, personally deliver your kit to a Heathkit Electronic Center. For warranty parts replacement, supply a copy of the invoice or sales slip.

If you prefer to ship your kit to the factory, attach a letter containing the following information directly to the unit:

- Your name and address.
- Date of purchase and invoice number.
- Copies of all correspondence relevant to the service of the kit.
- A brief description of the difficulty.
- Authorization to return your kit COD for the service and shipping charges. (This will reduce the possibility of delay.)

Check the equipment to see that all screws and parts are secured. (Do not include any wooden cabinets or color television picture tubes, as these are easily damaged in shipment. Do not include the kit Manual.) Place the equipment in a strong carton with at least THREE INCHES of *resilient* packing material (shredded paper, excelsior, etc.) on all sides. Use additional packing material where there are protrusions (control sticks, large knobs, etc.). If the unit weighs over 15 lbs., place this carton in another one with 3/4" of packing material between the two.

Seal the carton with reinforced gummed tape, tie it with a strong cord, and mark it "Fragile" on at least two sides. Remember, the carrier will not accept liability for shipping damage if the unit is insufficiently packed. Ship by prepaid express, United Parcel Service, or insured Parcel Post to:

Heath Company
Service Department
Benton Harbor, Michigan 49022

HEATH

Schlumberger

HEATH COMPANY • BENTON HARBOR

THE WORLD'S FINEST ELECTRONIC EQUIPMENT

LITHO IN U.S.A.

MP MASTER

MA22799